IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

IMAGE ENHANCEMENT USING SPATIAL DOMAIN FILTER THROUGH MATLAB

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Abstract: The aim of image enhancement is to improve the interpretability or perception of information in images for human viewers, or to provide `better' input for other automated image processing techniques such as biometric based techniques that include face recognition, fingerprint matching, early detection of biological disorder like cancer etc. Image enhancement techniques can be divided into two broad categories: spatial domain techniques, which operate directly on pixels, and frequency domain techniques, which operate on the Fourier transform of an image. Frequency domain image enhancement techniques are based on modifying the Fourier transform of an image. Smoothing domain filters, sharpening domain filters, Homomorphic filters are few of them which are used for image enhancement. In the present work such filters have been designed and implemented. A comparison has been made over aforesaid frequency domain image enhancement techniques using various filters and their performances have been evaluated in terms of PSNR (peak signal to noise ratio), CNR (contrast to noise ratio), mean, variance and invariant moments. For better visual interpretation of a color image a special technique color image enhancement has also been successfully implemented. The results of present research work have been applied to one of the forensic science applications i.e. fingerprint matching. It has been observed that matching accuracy is improved if fingerprint image is enhanced in frequency domain before subjecting it to the matching process**.**

Keyword: Salt & Pepper Noise, Gaussian Noise, Speckle Noise, Mean Filter, Median Filter, Gaussian Filter and Wiener Filter.

Introduction

Digital Image Processing (DIP) involves the modification of digital data for improving the image qualities with the aid of computer. The processing helps in maximizing clarity, sharpness and details of features of interest towards information extraction and further analysis. This form of remote sensing actually began in 1960s with a limited number of researchers analyzing airborne multispectral scanner data and digitized aerial photographs. However, it was not until the launch of Landsat-1, in 1972, that digital image data became widely available for land remote ensuing applications. At that time not only the theory and practice of digital image processing was in its infancy but also the cost of digital computers was very high and their computational efficiency was far below by present standards. Today, access to low cost and efficient computer hardware and software is commonplace and the source of digital image data are many and varied. The digital image sources range from commercial earth resources satellites, airborne scanner, airborne solid-state camera, scanning

micro-densitometer to high-resolution video camera.

Based on its nature, noise can be modeled as either an additive or a multiplicative process.

$$g\ x,y = f\ x,y + n(x,y)$$
$$g\ x,y = f\ x,y * n(x,y)$$

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Classification of Images

1. **Intensity Images :** An intensity image is a data matrix whose values have been scaled to represent intensities.
2. **Indexed Images:** Array of class logical, unit 8, Unit 16, single, or double whose pixel values are directed indices into a colour map.

3. **Binary Images**: A binary image is one that consists of pixels that can have one of exactly two colors, usually black and white. Binary images are also called bi-level or two-level.

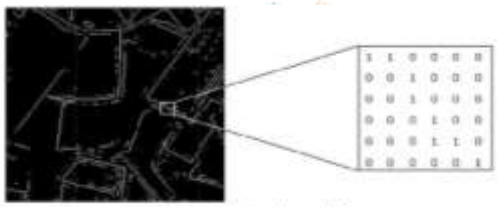


Figure 1.1: Binary Images [4].

4. **Grayscale Images:** A grayscale or greyscale image is one in which the value of each pixel is a single sample representing only an amount of light, that is, it carries only intensity information. Grayscale images, a kind of black-and-white or gray monochrome, are composed exclusively of shades of grey. The contrast ranges from black at the weakest intensity to white at the strongest.

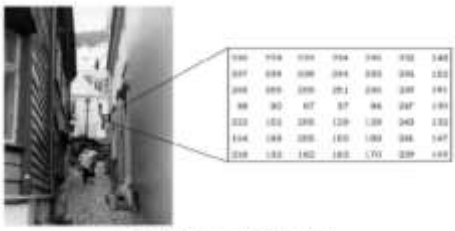


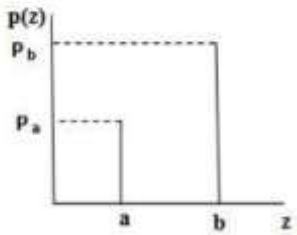
Figure 1.2: Grayscale Image [1].

5. **True Color Images:** A true color image, also known as an RGB image, is an image in which each pixel is specified by three values -- one each for the red, blue, and green components of the pixel's color. MATLAB store true color images as an m-by-n-by-3 data array that defines red, green, and blue color components for each individual pixel. True color images do not use a colormap.

- **SALT AND PEPPER NOISE:** This is a type of noise, which is also known as impulse noise, shot noise, and binary noise. It is caused by sensor and memory problems due to which the pixels are assigned incorrect maximum values.

The Probability density function (PDF) of Impulse noise

$$p(z) = \begin{cases} p_a & \text{for } z = a \\ p_b & \text{for } z = b \\ 0 & \text{otherwise} \end{cases}$$



PDF of Salt and Pepper Noise

(b) image with Salt & Pepper Noise

(a)original image

- **GAUSSIAN NOISE**

The random noise that enters the system can be modelled as Gaussian or normal distribution. The Gaussian distribution is a well-known bell-shaped curve. This is mathematically denoted as F = S ± Na, where Na is the Gaussian probability density function (PDF) and S is the noiseless image. The Gaussian noise affects both the dark and light areas of an image. The Gaussian distribution is

$$P(z) = \frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{(z-m)^2}{2\sigma^2}} \qquad [2]$$

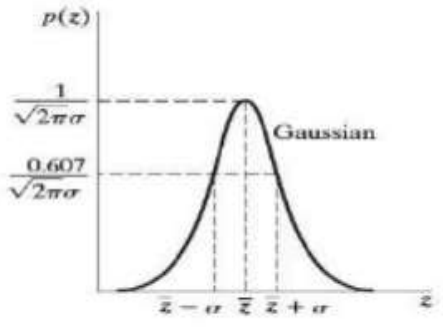


Figure 3: PDF of Gaussian noise [4]

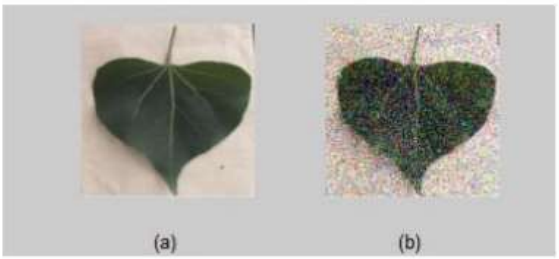


Figure 4: (a) Noiseless image (b) Image with Gaussian Noise, mean=0; variance=0.03

- **SPECKLE NOISE**

This noise is a type of multiplicative noise. It is generally found in medical images and appears as bright specks in the lighter parts of an image.

$I = S + (S * Ng)$ [2]

The above mathematical notation represents speckle noise, where Ng is the random noise, which has zero-Mean Gaussian probability distributive function.

Figure 5: (a) Noiseless image (b) Image with speckle noise of mean=0 and variance = 0.05

METHODOLOGY

Image Enhancement: Image enhancement is the process of adjusting digital images so that the results are more suitable for display or further image analysis. For example, you can remove noise, sharpen, or brighten an image, making it easier to identify key features.

1. Spatial domain method
2. Frequency domain method

Spatial Domain Filter: Spatial domain filter is a technique for modifying or enhancing an image. For example, you can **filter** an image to emphasize certain features or remove other features. Image processing operations implemented with filtering include smoothing, sharpening, and edge enhancement.

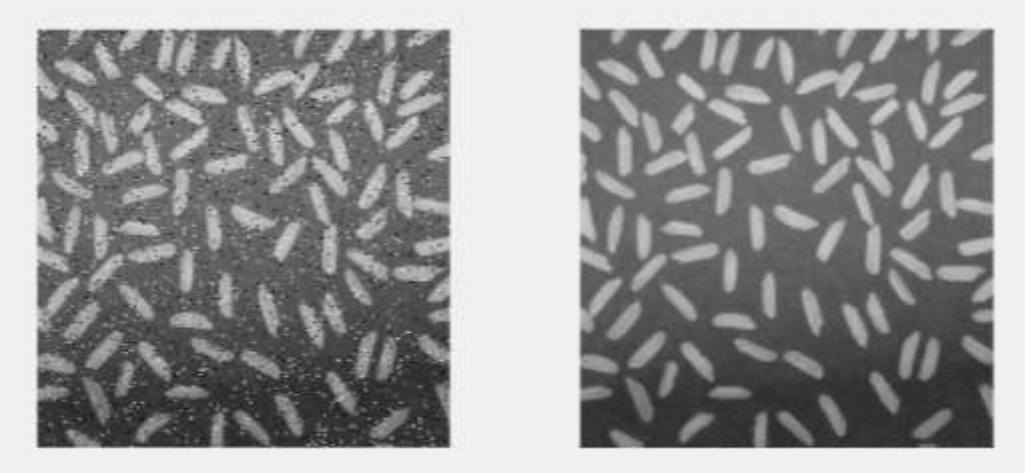
Frequency Domain Filter: Frequency Domain Filters are used for smoothing and sharpening of image by removal of high or low frequency components. Sometimes it is possible of removal of very high and very low frequency. Frequency domain filters are different from spatial domain filters as it basically focuses on the frequency of the images.

After this the study has been taken from the spatial domain method in filtering operations where two filters that is median and Averaging filters have been used to remove Salt and Pepper noise and Gaussian noise.

Result: In Salt and Pepper noise the noise is caused by sensor and memory problems due to which the pixels are assigned incorrect maximum values. We used median filter to remove it. It is not removed by Averaging filter.

Gaussian noise caused by the random noise in the system is removed by the Averaging filter and not by the median filter.

Below the figure after removing the Salt and Pepper noise by median filter:



CONCLUSION

The above discussion and various results obtained lead to the conclusion that it is easier to comprehend the concepts of Digital Image Processing and specifically various image enhancement techniques with the help of their simulation on MATLAB. When needed to image enhancement with a small kernel, would like to advise to use the spatial domain, instead of the frequency domain, since the Fourier transformation takes some time. Know that spatial domain is fast and less complex than Fourier filtering.

This paper has dealt with the application of spatial domain filters on 24-bit images and identified the following facts

- Median filter performs well in removing salt & pepper noise present in an image than Mean, Gaussian and Wiener filters.
- Wiener filter performs well in removing Gaussian and speckle noise present in an image rather than Mean, Median and Gaussian filters.

REFERENCES

The contents has been sourced from the following sources :

[1] http://in.mathworks.com/help/images/noise-removal.html.

[2] Digital Image Processing, S. Sridhar, Oxford University Press.

[3] Performance Comparison of Various Filters for Removing Gaussian and Poisson Noises, Pratap Singh Chahar, VandanaVikas Thakare, International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056 Volume: 02 Issue: 05 | Aug-2015.w

[4] Performance Comparison of Various Image Denoising Filters Under Spatial Domain, Inderpreet Singh Nirvair Neeru, International Journal of Computer Applications (0975 – 8887) Volume 96-No.19, June 2014.

[5] A Study of Digital Image Filtering Techniques in Spatial Image Processing,Nayan Patel Abhishek Shah Mayur Mistry Kruti Dangarwala, International Conference on Convergence of Technology – 2014 , 978-1-4799-3759-2/14/©2014 IEEE.

[6] http://ethesis.nitrkl.ac.in/1529/1/PhD_Thesis-bhoi.pdf.

[7] Image De-noising by Various Filters for Different Noise, Pawan Patidar, Manoj Gupta, Sumit Srivastava, Ashok Kumar Nagawat, International Journal of Computer Applications (0975 – 8887) Volume 9– No.4, November 2010.